When is $1+1\neq 2 \ldots$ When Adding Vectors!

What is a Vector?

- A **measureable quantity** that contains 
  - **magnitude** (value) and **direction**

**Scalars:** a quantity that contains only 
- magnitude: eg. time, mass, speed

**Example:**
- Scalar: car travelling at 35 km/h (speed)
- Vector: car travelling at 85 km/h due north (velocity)

Vectors are shown by arrows:

- **Magnitude** is shown by the length
- **Direction**

![Diagram of vectors in different directions](image_url)
II. Adding and Subtracting Vectors

\[ \vec{R} = 87 \text{ m (E)} \]

\[ 72 \text{ m (E)} \]
Sum it Up:

Vectors at Right Angles:

\[ R^2 = a^2 + b^2 \]
\[ \frac{a}{b} = 1 \text{ BK.} \]
\[ c^2 = a^2 + b^2 \]

Pythagorean:

\[ R^2 = a^2 + b^2 \]
\[ a = 1 \text{ BK.} \]
\[ b = 1 \text{ BK.} \]

Total distance:
\[ = 1 + 1 = 2 \text{ BK.} \]

Displacement:
\[ R = \sqrt{2} \text{ BK.} \]
\[ R = 1.414 \text{ BK.} \]

\[ R = 1.414 \text{ BK. at } 45^\circ \text{ S Q E} \]

Now Try These:

a) \[ R = 15 \text{ m} \]
\[ \theta = 90^\circ \]
\[ R = 18 \text{ m at } 34^\circ \text{ S Q E} \]

b) \[ R = 72 \text{ m} \]
\[ \theta = 90^\circ \text{ S Q E} \]
\[ R = 210 \text{ m} \]
\[ R = 680 \text{ m} \]
Side Trip to.... TRIG LAND! !

SOH CAH TOA

SOH $\Rightarrow \sin \varnothing = \frac{\text{opposite}}{\text{hypotenuse}}$

$\sin \varnothing = \frac{O}{H}$

$O = H \times \sin \varnothing \star$

CAH $\Rightarrow \cos \varnothing = \frac{\text{adjacent}}{\text{hypotenuse}}$

$\cos \varnothing = \frac{A}{H}$

$A = H \times \cos \varnothing \star$

TOA $\Rightarrow \tan \varnothing = \frac{O}{A} \Rightarrow \text{to solve for angle}$

Component Vectors:

Any vector can be re-written as the sum of two orthogonal (right-angle) component vectors

$\vec{a} = 40 \text{ N}$

Vertical component

$A_y = a \times \sin \varnothing$
\[ a = 40 \text{ N} \]

\[ a_y = a \times \sin \theta \]
\[ = 40 \times \sin 15^\circ \]
\[ = 10.4 \text{ N } \uparrow \]

\[ a_x = a \times \cos \theta \]

Horizontal component

\[ a_x = 40 \times \cos 15^\circ \]
\[ = 40 \times 0.966\overline{9} \]
\[ = 38.6 \text{ N } \rightarrow \]

Now Try These:

\( \text{a) } \)

\[ 35 \text{ m} \]

\[ 220^\circ \]

\( \text{b) } \)

\[ 6.7 \text{ m/s}^2 \]

\[ 55^\circ \]

\( \text{c) } \)

\[ 270^\circ \]

\( \text{d) } \)

\[ 560 \text{ km/h} \]

\[ 1^\circ \]